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MARIJUANA CONSUMPTION AND THE PERCEPTION OF HARM

by

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Submitted to the Graduate Faculty
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for the degree of
Masters of Science, Applied Economics

Grand Forks, North Dakota
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2014

This thesis, submitted by David Andrew Ruggeri in partial fulfillment of the requirements for the Degree of Master of Science, Applied Economics from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done, and is hereby approved.

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Title	Marijuana Consumption and the Perception of Harm
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David Andrew Ruggeri
December 3, 2014

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To Karen, Donato, and Matteo

ABSTRACT

Drug use is a public health issue with one-third of the United States population having reported consuming marijuana at some point in their lifetime. This paper examines how the perception of risk (both health and criminal sanctions) affects consumption behavior. This study examined marijuana consumption for the age ranges of 12-17, 18-25, and 26 and older during the years of 1999-2007.

Perceptions of health risk of marijuana vary from by age groups (12-17, 18-25, and 26 years of age and up). Persons age 26 and older perceive the health risks to be the greatest for occasional marijuana consumption, trailed by youth age 12-17, and 18-25 with the lowest perception of health risk. Residing in a medical marijuana state was the strongest single predictor of past month marijuana use. Marijuana possession criminal classification for marijuana possession was the second strongest influencer, marijuana health risk perception was third strongest, residing in a marijuana decriminalized state is fourth, and marijuana price per gram was fifth strongest respectively. Possible maximum monetary fine for marijuana possession was the weakest influencer on past month marijuana consumption with almost zero influence.

CHAPTER I

INTRODUCTION

Drug use is a major public health issue in the United States (Winters, 2003). Marijuana is the most commonly used illicit drug in the developed world, with one-third of the population in both Australia and the United States have reported consuming marijuana at some point in their lifetime (Williams, 2004). In 2010 U.S. residents spent between \$30 billion and \$60 billion on marijuana ("What America's Users Spend on Illegal Drugs: 2000-2010," 2014).

The purpose of this paper is to attempt to identify how the perception of risk (both health and criminal sanctions) affects marijuana consumption. This study examined marijuana consumption for the age ranges of 12-17, 18-25, and 26 and older during the years of 1999-2007, and how the perception of risk influenced consumption patterns.

Increasing prevalence of regular cannabis use, as well as new epidemiological research on the hazards of marijuana consumption, are prompting policy makers to view cannabis as a potential serious health risk (Hall & Babor, 2000). Since the 1970s, the proportion of young people who have used cannabis has dramatically increased while the age of first use has declined (Hall, 2006) and more adults in the United States had a marijuana disorder in 2001-2002 than in 1991-1992 (Compton, Grant, Colliver, Glantz, & Stinson, 2004). The actual prevalence of marijuana smoking is likely higher than is

reported due to the fact that national surveys under-represent high school dropouts and those whose drug use is higher than the surveyed population (Tashkin, 1993).

Marijuana smoke contains significantly more carcinogens (Marselos & Karamanakos, 1999; Zhang et al., 1999) and deliver more tar to the lungs than tobacco smoke (Mehra, Moore, Crothers, Tetrault, & Fiellin, 2006). When consuming marijuana larger puff volumes are taken and the smoke from marijuana is inhaled more deeply. This results in the individual retaining smoke in his or her lungs, approximately four times longer than tobacco smoke, and a larger amount of tar retained in the lung (Mehra et al., 2006; Sherman, Roth, Gong Jr., & Tashkin, 1991).

Biological evidence does support a correlation between marijuana smoking and the development of lung cancer in humans (Mehra et al., 2006). Strong evidence does exist that demonstrates that cannabis smoke produces mutations in cells in both test tubes and within live animals and therefore can be a potential cause of cancer (Hall, Degenhardt, & Lynskey, 2001). Taylor reviewed surgical pathology reports of patients under the age of 40 who had been diagnosed with respiratory tract carcinoma (a malignant tumor). Marijuana use of these patients was then examined, and the author concluded that regular marijuana use adds significant risk for the development of respiratory tract carcinoma (F. M. Taylor, 1988).

A study conducted between 1992 and 1994 examined the relationship between marijuana consumption and cancer of the head and neck. Patients with cases of confirmed squamous cell carcinoma (skin cancer), along with a control group of cancer-free persons completed questionnaires concerning tobacco, alcohol, and marijuana use. The authors

concluded that marijuana use may increase the risk of head and neck cancer (Zhang et al., 1999).

Exposing a correlation between marijuana smoking and various forms of cancer is complicated due to the fact that many marijuana users also exposed themselves to additional risk factors such as tobacco and alcohol consumption. However, Caplan and Brigham reported two cases of marijuana smoking and carcinoma of the tongue in which both males (age 37 and 52) denied any tobacco or alcohol consumption but reported heavy marijuana use (Caplan & Brigham, 1990). Almadori et al. described a case of a 23-year-old male suffering from cancer of the tongue. This case was unusual due to the fact that persons under the age of 30 are diagnosed with this form of cancer in only approximately 3% of cases of head and neck cancers (Randall & Shaw, 1986). This patient smoked cigarettes and was also a self-reported “regular” marijuana smoker. This study concluded that the addition of marijuana may have contributed to his condition due to the young age of the patient and the relatively short period of being a cigarette smoker (Almadori, Paludetti, Cerullo, Ottaviani, & D'Alatri, 1990).

One study demonstrated an association between marijuana use and the incidence of testicular germ cell tumors (TGCT) (Daling et al., 2009). This study, consisting of 1,348 males (369 with TGCT and 979 without) age 18-44, stated that marijuana use produces adverse effects on the human endocrine and reproductive systems that resulted in a 70 % increased risk of TGCT. This health risk was elevated for weekly, or greater, current marijuana use or marijuana use that began in adolescence.

A 1997 published study demonstrated that among non-tobacco smoking persons, marijuana use was linked to an increased risk of prostate cancer (Sidney, Quesenberry,

Friedman, & Tekawa, 1997). This study, conducted between the years of 1979 and 1985, examined 64,855 patients of Kaiser Permanente in San Francisco and Oakland, California. Self-administered questionnaires measured smoking habits of both marijuana and tobacco. A follow-up examination of incidence of cancer was also conducted in 1993, which resulted in the researchers concluding that marijuana use by non-cigarette smokers may have an increased risk for some “site-specific” cancer risks (Sidney et al., 1997). Although this study does possess some limitations, it does raise questions of potential hormonal alterations due to marijuana consumption (Sidney et al., 1997).

Marijuana use has also been shown to negatively affect the female reproductive system by suppressing the plasma levels of luteinizing hormone during the luteal phase of the menstrual cycle, shortened luteal phase and overall cycle length and anovulation (Holt, Cushing-Haugen, & Daling, 2005). Holt et al. also concluded that an increased risk of ovarian cyst cancer exists for underweight and normal-weight females who use marijuana. Marijuana use among non-tobacco using females is also associated with an increased risk of cervical cancer (Sidney et al., 1997).

Several studies have been conducted to determine the correlation between marijuana consumption and negative mental health conditions. One longitudinal study utilizing data gathered from the Netherlands Mental Health Survey and Incidence Study, in which subjects were contacted once during the years 1996, 1997 and 1999, concerned the prevalence, incidence, course, and consequences of psychiatric disorders (van Os et al., 2002). The initial numbers of subjects contacted in 1996 was 7,076, with that number dropping to 5,618 in 1997, and 4,848 in 1999. This study concluded that psychosis-free

subjects who have a lifetime history of cannabis use are at increased risk of a psychosis outcome (van Os et al., 2002).

A 2007 meta-analysis further demonstrated the relationship between cannabis use and the risk of future onset of psychosis. The authors concluded that the risk of psychosis increased by approximately 40% by persons who have used cannabis, and that there is dose-response effect leading to an increased risk of 50-200% in the most frequent users (Nordentoft & Hjorthoj, 2007). Findings such as this can have a tremendous effect on influencing future health outcomes. For example, assuming an increased risk of psychosis of 40 % and a 40 % lifetime cannabis use among young adults in the UK, then one could expect a 14% reduction in psychotic outcomes if cannabis was not used in that society (Nordentoft & Hjorthoj, 2007).

Cannabis use has been associated with both positive and negative dimensions of psychosis, independent of each other, and depression (Stefanis et al., 2004). Furthermore, research on brain development clearly demonstrates that the adolescent brain, which is still developing, is particularly vulnerable to the ill effects of substance abuse, including marijuana (Joffe, 2005). These findings were similar to a previous analysis conducted by Arseneault et al., who concluded that heavy cannabis use at the age of 18 increased the risk of later schizophrenia six-fold (Arseneault et al., 2002). Cannabis use may trigger schizophrenia in persons who are vulnerable to the disorder; cannabis may also be used to “self-medicate” schizophrenia symptoms (Hall, 2006). The difficulty lies in deciphering the degree of correlation and the assumptions surrounding persons who may be predisposed of certain behaviors.

Marijuana intoxication has also been implicated as a risk factor for injuries (Polen, Sidney, Tekawa, Sadler, & Friedman, 1993). Chronic marijuana users have also been shown to have impairments in attention, memory, and the ability to process complex information for months or even years after ceasing marijuana consumption (Ashton, 2001).

In addition to health-related issues, marijuana consumption places tremendous costs onto society. One 1992 study quantifies the social cost of marijuana at \$7.2 billion, or 8.9% of drug-related social costs, such as increased healthcare, loss of productivity, and lower educational level of attainment (Caulkins, Pacula, Paddock, & Chiesa, 2002). The authors admittedly concede that this measure is less precise than that of other drug-related social costs due to marijuana “rarely being the sole or principal cause of measurable harms such as an overdose.” Additional estimates argue that the social value of averting or delaying each case of schizophrenia is approximately \$500,000, which greatly exceeds the per-patient lifetime cost-of-illness estimates for psychotic disorders (Pollack & Reuter, 2007). Pollack and Reuter further argue that a 20% reduction in marijuana use would be associated with a \$600 million savings in averted social costs.

Additional social costs result from marijuana use hindering personal achievement, such as graduating from high school. Failure to graduate from high school can be related to a lack of occupational opportunities, lower lifetime earnings, reduced community involvement, and lower self-esteem. High school graduation is negatively associated with marijuana use. More specifically a 10% increase in frequent marijuana use lowers the probability of graduation by 6.62% (Yamada, Kendix, & Yamada, 1996). Other researchers have further investigated this hypothesis. Studies have demonstrated a

correlation between marijuana consumption and low grade point averages, decreased attendance, and an increased drop-out rate. A study published in 1996 of 1,000 youths concluded that 22.5% of youths who self-reported cannabis use before the age of 15 had dropped out of school by the age of 16 (Lynskey & Hall, 2000).

Fergusson and Horwood conducted a longitudinal cohort study of youths born in Christchurch, New Zealand in 1977. The youths were studied at birth, 4 months, 1 year, annually through age 16, and finally at age 18. Early onset marijuana users had significantly higher rates of later substance use, juvenile offending, mental health problems, unemployment, and dropping out of school (Fergusson & Horwood, 1997). Youths aged 15-16 years old who consumed marijuana on more than 10 occasions are almost four times more likely to drop out of school than a youth the same age who had never consumed marijuana, and almost ten times more likely to have attempted suicide (Fergusson & Horwood, 1997).

Cannabis is an addictive substance and the addiction can result from experimentation and recreational use (van den Brink, 2008). Marijuana dependence is defined in the *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition) as increased tolerance, compulsive use, impaired control, and continued use despite physical and psychological problems caused or exacerbated by use (*Diagnostic and statistical manual of mental disorders*, 2000). Marijuana is much more potent now than it was in the 1960s and 1970s, which is one explanation why cannabis-use disorders in the United States have increased over the past 10 years (Joffe, 2005). Surveys in both the United States and Australia show that cannabis dependence is the most common form of dependence after alcohol and tobacco (Hall et al., 2001).

A growing body of research has examined the relationship between the genetic epidemiology of addiction. Approximately 10% of marijuana users become dependent on the drug (Anthony, Warner, & Kessler, 1994). In 2011 approximately 4.2 million persons met the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) diagnostic criteria for marijuana use or dependence ("Substance Abuse and Mental Health Services Administration," 2012). It has been suggested that marijuana use, abuse, and dependence tend to aggregate in families (Agrawal & Lynskey, 2006). The risk of marijuana dependence is higher for daily users and persons who begin consuming marijuana at an early age (Coffey, Carlin, Lynskey, Li, & Patton, 2003). Additional health concerns are raised due to the increased potency of marijuana consumed today versus the past. Consumption patterns may be negatively affected by this increase of potency. As the potency of marijuana increases the amount consumed may decrease if users adjust to keep the amount of THC per day of use stable ("What America's Users Spend on Illegal Drugs: 2000-2010," 2014). Consumption of marijuana may be characterized by reinforcement (greater past consumption increases the desire for present consumption), tolerance (utility of a given consumption level is lower when past consumption is higher), and withdrawal symptoms (fall in utility from abrupt cessation in consumption pattern) (Bretteville-Jensen, 2006). This dependence can lead to serious withdrawal symptoms once the stimulant is removed.

Withdrawal symptoms have been reported by 80% of male and 60% of female adolescents seeking treatment for cannabis dependence (Hall, 2006). These withdrawal symptoms are similar to those of alcohol, opiates, and benzodiazepine withdrawal, which

includes restlessness, insomnia, anxiety, increased aggression, and muscle tremors (Ashton, 2001).

The risk of death from marijuana overdose is incredibly low. There are no reported cases of human deaths attributed to cannabis toxicity (Hall et al., 2001). That is not to say that cannabis toxicity is not possible: it is just extremely unlikely that a person can consume the quantity needed to cause death. On average, one “joint” delivers 3 mg of THC to the consumer while the lethal dose is approximately 4,000 mg of THC (Gable, 1993) or more than 1,300 “joints.”

Marijuana Regulation

Opponents of marijuana prohibition argue that the legalization of marijuana will allow the market to operate in the most efficient manner. Drugs such as marijuana, cocaine, and heroin have not created any market failures that justify an outright ban of these substances, and our present drug policy has led to an increase in crime, social disruption, and decreased respect for law enforcement (Block, 1993). Additional points of view stem from the philosophical perspective, arguing that drug prohibition severely threatens our civil liberties and is inconsistent with the anti-slavery philosophy and the founding documents of the United States (Cussen & Block, 2000). This stance posits that allowing for the free trade of marijuana will lead to an outcry from those who oppose consumption of such a good, but other legal products produce similar reactions, such as products tested on animals.

Adding to this stance is the viewpoint that legalizing and taxing marijuana in the same way as other goods will generate a tremendous amount of revenue for federal, state,

and local governments. The exact amount of the tax and amount generated is purely speculative at this point in time. Finding an optimal tax rate is a complex and daunting proposition. An optimal tax rate may exist that maximizes revenues and minimizes crime, addiction, and youth consumption but the history with alcohol has demonstrated the difficulty in finding the most efficient and effective tax rate (Wilson, 1990).

Drug policies are costly ones, but the exact costs are unclear. Rigter (2006) analyzed the costs of drug policies in the Netherlands for four distinct areas (prevention, treatment, harm reduction, and enforcement) for the 2003 calendar year. Although the Netherlands is “soft” on personal marijuana possession and consumption, they allocate a tremendous amount of capital to drug policies. For example, in 2003 the Dutch government spent approximately €41.5 million (\$52.2 million USD) on prevention alone, with 25% of that amount devoted to school drug prevention programs and advertising campaigns (Rigter, 2006). Law enforcement is the largest expenditure of the four components of the Dutch drug policy. Enforcement expenditures in 2003 totaled €1.65 billion (\$2.1 billion USD), €277.6 million (\$349 million USD) for treatment, and €220 million (\$276.8 million USD) on harm reduction (Rigter, 2006).

This distribution of resources is similar to the drug policy spending in Sweden. Although Sweden spends far less in total Euros than does the Netherlands, their percentage spending of the total budget is comparable. Both countries allocated 76% of their drug control budget to enforcement in 2002-03, with Sweden outspending the Netherlands in the area of treatment 19% to 13% respectively, and the Netherlands outpacing Sweden in spending for both prevention (2% to 1%) and harm reduction (9% to 0.1%) (Reuter, 2006).

The United States has been publishing such data for approximately 35 years, although this collection of data does not include the expenditures of state and local governments (Carnevale & Murphy, 1999). From 1970-76, the majority of spending was focused on reducing the demand-side of the drug problem. This spending shifted in 1977, when spending shifted to reducing the supply of illegal drugs (Carnevale & Murphy, 1999). In 2011 the U.S. spent approximately \$15.5 billion on the War on Drugs, or just less than \$500 per second (ONDCP, 2010)

Marijuana legalization in the United States would reduce government yearly enforcement expenditures by approximately \$7.7 billion while simultaneously generating a tax revenue of \$6.2 billion if marijuana was taxed at rates similar to alcohol and tobacco or \$2.4 billion if taxed like other goods (Miron, 2005), resulting in a potential \$14 billion that could be allocated to other budget items. Of that \$7.7 billion, more than \$5 billion of the cost is incurred by state and local governments (Miron, 2005). In 2004 alone the State of Alaska directly spent approximately \$16 million for marijuana prohibition, including law enforcement and adjudication by the courts, and an additional \$8 million on indirect costs such as lost output and negative impacts on family (Bates, 2004).

Although marijuana is illegal on the federal level, some states have decriminalized possession and cultivation for personal and/or medical purposes. The National Commission on Marijuana and Drug Abuse defined decriminalization as those policies in which possession of marijuana for personal use or casual distribution of small amounts not intended to generate profits was not considered a criminal offense ("Marihuana: A signal of misunderstanding," 1972). This decriminalization has led to a

decrease in the costs of consuming marijuana. As the costs of consumption fall, marijuana use can be expected to increase. However, results from various studies have done little to produce a consensus.

Legal Considerations

Potential negative effects of marijuana legalization include further harm to low-income urban areas. These urban areas bear a disproportionate share of social costs of the illegal drug trade, while also possibly receiving a disproportionate share of the economic gain associated with illegal drug sales (Warner, 1991). This may be caused by the elimination of the black market drug trade, thusly further eliminating a means of economic gain for persons in this poor urban area, while other more affluent areas will not be affected as much.

Decriminalization is not the same as legalization. Under a system of decriminalization, marijuana is still technically illegal. Laws remain on the books; however, law enforcement and other authorities at the federal, state, or local level simply choose not to enforce many marijuana laws. Decriminalization models are most often applied to areas where users primarily possess and consume small amounts of marijuana. These individuals would no longer face the threat of a custodial arrest for such actions. In 1973, Oregon was the first state to decriminalize marijuana; followed by Colorado, Alaska, and Ohio in 1975; California, Maine, and Minnesota in 1976; Mississippi, New York, and North Carolina in 1977; and Nebraska in 1978 (MacCoun & Reuter, 2001).

Local-level examples of pre- and post-tests have been used to study of the effects of marijuana decriminalization. In November of 1975, Ohio effectively decriminalized

marijuana. Surveys conducted of persons aged 18-24 revealed that marijuana use among that group increased from 6% from 1974 to 19% in 1978 (Single, 1989). California also collected data appropriate to analyze their policy change. From February 1975 to November 1976 the number of adults reporting that they had ever used marijuana increased from 28% to 35% (Single, 1989).

Additional research in this area suggests that decriminalization or legalization of marijuana, which will lead to a reduction of the full price of marijuana, would almost certainly lead to an increase in marijuana consumption (Chaloupka & Laixuthai, 1997). This study by Chaloupka and Laixuthai, consisting of data collected from the 1982 and 1989 Monitoring the Future surveys of high school seniors, also demonstrated that lowering the price of marijuana, by either lower monetary prices and/or reduced legal sanctions, would lead youths to substitute marijuana for higher priced alternatives such as alcoholic beverages and other intoxicants, indicating that these substances are economic substitutes.

However, results from studies concerning the end result of marijuana decriminalization in the U.S. vary. Williams found that decriminalization does not in fact appear to increase the likelihood of marijuana use among young males and females (Williams, 2004). Williams argued that marijuana decriminalization is correlated to an increased possibility of use in males over the age of 25 but not for younger persons, concluding that the monetary cost of marijuana does play a role in consumption levels for younger people who are more price sensitive than older groups. A separate study concluded that decriminalization increases the probability of smoking marijuana by 16.2% (Damrongplasit, Hsiao, & Zhao, 2010). Pacula, Chriqui, and King concluded that

youths residing in a state that has decriminalized marijuana are 2% more likely to use that drug in both the past year and the past month (Pacula, Chriqui, & King, 2003).

A study of first-year students enrolled at the University of Western Australia concluded that legalizing marijuana would lead consumption to increase by approximately 4% with marijuana prices remaining at current levels, however, legalization coupled with a 50% price decrease of marijuana would lead consumption to increase by approximately 11% (Daryal, 1999). This study also concluded that persons who are more frequent users of marijuana are more price responsive than those who consume marijuana on a less frequent basis. A 2005 study of Australian youth also drew interesting conclusions concerning price and consumption. Researchers demonstrated that low marijuana prices are correlated with early initiation of marijuana use and a longer duration of use (van Ours & Williams, 2007).

Criminal Penalties

Although the number of persons arrested for marijuana possession has increased in absolute numbers, the percentage of arrests has remained steady. Regional variations in arrests exist. Driven largely by police department policies and specific initiatives, considerable discrepancies in marijuana arrest rates throughout the country exist. For example in the 1990s New York City implemented a program to increase arrests for persons using marijuana in public view. This initiative was a subset of quality-of-life policing which was intended to promote public order in public locations by aggressively targeting persons who engage in activities that offend the general public (Golub, Johnson, & Dunlap, 2006). In 2000, 15% of all arrests by the New York City Police Department

were for marijuana in public view violations, most of which were located in high poverty and minority communities (Golub et al., 2006).

Some communities focus on drug enforcement for reasons other than quality-of-life benefits. Mast et al. demonstrated that in communities where state or local legislation allows for police departments to retain a portion of assets seized during drug arrest the percentage of drug arrests increase by approximately 18% (Mast, Benson, & Rasmussen, 2000). This study implies that police departments will allocate more resources to drug enforcement when they are able to increase their departments' budgets through asset seizures than when these financial incentives are not present.

In 2010, 13,120,947 persons were arrested (excluding traffic violations) in the United States ("Crime in the United States," 2011). Of the persons arrested 1,643,846 person were arrested for drug abuse violations. Of this 1.6 million, just under 45.8% was for marijuana possession, accounting for 12.5% of the total arrests for the year 2010 in the U.S. The percentage of arrests for marijuana possession as a proportion of all illegal drug arrests declined from the 1970s through the 1990s. In 1978, approximately 60% of the arrests for illegal possession were related to marijuana, falling to approximately 35% in 1996 (Ostrom & Kauder, 1999). During this time law enforcement shifted priorities from marijuana to other drugs such as crack cocaine, which was labeled an epidemic beginning in the 1980s.

In 2000 approximately 734,000 persons were arrested for marijuana-related offenses, which resulted in only 41,000 felony convictions, producing only one felony conviction for every eighteen persons arrested (King & Mauer, 2006). Marijuana dealers carry less risk than heroin dealers; the average heroin dealer can expect to spend

approximately 35% of his/her dealing career incarcerated while marijuana dealers only spend 1% of their tenure incarcerated (Reuter & Kleiman, 1986).

Previous research has demonstrated that punitive sanctions have little influence on marijuana usage, and monetary penalties possess little threat to users. One explanation is that the general public does not know the level of monetary fines that a conviction for marijuana possession carries. Individuals are generally poor judges of the certainty and severity of criminal sanctions (Apel, 2013). Approximately one-third of households do not know what the maximum penalty for marijuana possession is in their state (Pacula, Kilmer, Grossman, & Chaloupka, 2007a). These findings suggest that changes in monetary penalties will have little effect due to the nonexistent dissemination of this information to the states' residents.

Reduced jail time and lower sanctions are correlated with greater marijuana use; however, this increase is relatively small and removing these penalties has little effect on consumption (Pacula, Kilmer, Grossman, & Chaloupka, 2007b). People are not oblivious to marijuana laws, their knowledge of the facts are shaky at best, and their recollection of penalties revolves around information garnered through the policy debate of alternatives and not the actual implementation (MacCoun, Pacula, Chiqui, Harris, & Reuter, 2008). This suggests that deterring marijuana consumption through increasing price rather than criminal sanctions may offer substantial social benefits and must be considered as a viable policy choice (Cameron & Williams, 2001).

A study, consisting of data from the 1990-1996 National Household Survey on Drug Abuse (NHSDA), developed a measure of the probability of being arrested for marijuana possession, which consisted of dividing the number of marijuana possession

arrests for youths aged 12-20 by the number of current young (also aged 12-20) marijuana consumers. Arrest data were retrieved from the Uniform Crime Reports for the years 1990-1996. Farrelly et al. demonstrate that a 10% increase in the probability that a marijuana user is arrested for possession decreases the probability of use by roughly 3% (Farrelly, Bray, Zarkin, & Wendling, 2001).

A number of law enforcement agencies focus their resources on other illegal activities, thus giving unscrupulous and resourceful criminals an opportunity to operate within the illegal drug market without the high costs of arrest, fines, and possible jail time associated with other criminal activity. When given a choice on supplying the illegal drug market or illegal firearms market most criminals choose the drug market due to high transaction costs within the gun market (Cook, Ludwig, Venkatesh, & Braga, 2007). Gun violence in the U.S. also carries with it tremendous costs on society, estimated to be in the order of \$100 billion per year (Cook & Ludwig, 2000). Regulations exist to prohibit some members of society from owning and/or possessing a firearm, namely youths and persons with specific criminal records. For example, the federal felon in possession of a firearm statute prohibits persons with certain criminal convictions from any court, including foreign, from possessing firearms (D. K. Taylor, 2004). Due to these restrictions, illegal firearm markets have been established. However, the illegal firearm market has lagged dramatically behind the illegal drug market in ease of access, profitability, and breadth.

Law enforcement activities appear to be more effective in suppressing the supply in the illegal gun market than in other underground markets, such as illegal drugs, partially due to the fact that street gangs that are well-positioned to deal in the gun market

avoid doing so for fear of attracting more serious police attention, thereby jeopardizing the profits associated with the more lucrative drug trade (Cook et al., 2007). One reason for this is that the police may view gun possession more seriously than possession of some illegal narcotics, therefore acting more aggressively in seeking out those who carry illegal firearms due to the threat of potential violence.

Medical Marijuana

In 2006 the Food and Drug Administration (FDA) issued a statement asserting that marijuana smoking is not approved for the treatment of any medical condition or disease (Harris, 2006). Federal drug policy defines marijuana as a Schedule I drug largely due to the drug's well-known psychoactive effects, commonly referred to as the "high" (Chapkis, 2007). The Institute of Medicine (IOM) has also weighed in on the topic of using marijuana for medical purposes. In 1999 the IOM issued a report titled "Marijuana and Medicine: Assessing the Science Base." The IOM stated that smoking marijuana is in fact a THC delivery system, but also delivers harmful substances, and therefore smoked marijuana should generally not be recommended for medical use (Joy, Stanley J. Watson, & John A. Benson, 1999).

This report, although more than 10 years old, still stands as the "clearest statement of scientific understanding about the therapeutic potential of marijuana" ("IOM report still sets standard on medical marijuana," 2009). The IOM report further stated that the "future of cannabinoid drugs (substances that are structurally related to tetrahydrocannabinol or THC, the psychoactive ingredient in marijuana) lies not in smoked marijuana but in chemically defined drugs that act on the cannabinoid systems

that are a natural component of human physiology.” However, the United States Court of Appeals for the Ninth Circuit in San Francisco heard arguments in April of 2009 concerning a lawsuit originally filed in 2007 challenging the government’s skepticism about medical uses of marijuana (McKinley, 2009).

Many in the medical community, including physicians, psychiatrists, and addiction specialists, warn that the medical community should be cautious before declaring marijuana as “safe” (Moran, 2009). One study of 42 medical marijuana patients concluded it was difficult or impossible to separate the medical benefits of marijuana from its high-generating effect (Chapkis, 2007). In spite of studies such as this, the number of states passing medical marijuana ordinances has increased. As of March 2009 dispensing marijuana for medical purposes is legal in 13 states (Moran, 2009) and the number of medical marijuana dispensaries is certain to increase in the coming years. The American College of Physicians has called for a reclassification of marijuana from a Schedule I drug (one that is deemed to have high abuse potential and no proven medical purposes) to a different schedule which would make the drug more readily available to researchers and clinicians (Moran, 2009). A reclassification could possibly lead to more concrete studies of the actual effectiveness and efficiency of medical marijuana in treating many ailments. More scientific research is needed when studying medical marijuana use because many of the effects of the drug will not show up in an eight-week trial (Moran, 2009).

The most recent Bush Administration’s view was that federal marijuana laws took precedent over state law, but now President Obama stated that he would be a supporter of medical marijuana use, saying in November 2007 that “there’s no difference between

(marijuana) and morphine when it comes to just giving people relief from pain” (Alexander, 2009). Following President Obama’s 2009 initiative to stop using federal marijuana laws to override state laws to punish consumers of marijuana for medical purposes, the requests for information by persons who wish to obtain certifications that allow individuals to purchase, possess, and consume medical marijuana have increased up to 300% (Alexander, 2009).

Pro-marijuana groups have also applauded recent remarks by Attorney General Eric Holder, Jr., who has suggested that federal law enforcement resources would not be used to pursue legitimate medical marijuana users in states that have laws allowing for medical use of the drug, but National Organization for the Reform of Marijuana Laws (NORML) director Allen St. Pierre cautioned that any legal changes would most likely be only incremental (McKinley, 2009).

Medical marijuana supporters have downplayed the psychoactive effect (the high) and instead argued for the medical utility and therapeutic potential of marijuana use (Chapkis, 2007). Supporters point to medical marijuana as a means to soothe and treat ailments for AIDS patients, offer relief from glaucoma, and reduce nausea in cancer patients.

However, data retrieved from records seized from medical marijuana dispensaries in San Diego from October 2005 through July 2006 by the Drug Enforcement Agency indicated that only 2% of medical marijuana consumers indicated their medical condition as AIDS, glaucoma, and/or cancer (ONDCP, 2008). The remaining 98% listed their medical condition as muscle spasms, insomnia, back/neck/post-surgical pain, anxiety, headache, and other.

In Colorado, Christian Thurstone M.D., a board certified child/adolescent and addictions psychiatrist, reviewed all persons who have received medical marijuana licenses to consume medical marijuana and discovered only 3% have cancer and 1% have HIV (Thurstone, 2010). Moreover, 90% of Colorado medical marijuana patients received their license with “pain” being the medical condition on record (Thurstone, 2010). Dr. Thurstone also describes an instance when a young, pregnant woman was recommended (physicians cannot prescribe marijuana but state laws allow for them to recommend its use) medical marijuana due to nausea.

With few restrictions and regulations on medicinal marijuana the potential for abuse is high. Medical marijuana dispensaries are attracting youths in greater numbers, due to the fact that youths are more likely to abuse marijuana. Medical dispensary customers are relatively young, with four out of five being 40 or younger (ONDCP, 2008).

CHAPTER II

METHODS

For the scope of this paper, state level data for marijuana consumption during the years of 1999-2007 will be examined. Data for this paper were gathered from the National Survey on Drug Use and Health (NSDUH) (smoked marijuana past month and perception of great risk of smoking marijuana once a month), The Price and Purity of Illicit Drugs report (marijuana prices), MayaTech Corporation (marijuana penalties), and ProCon.org (medical marijuana states).

One focus of the NSDUH is to collect data concerning substance prevalence, use, and abuse. Information is collected regarding alcohol, tobacco, and drug use in frequencies and quantities ranging from lifetime use, yearly use, monthly use, as well as date of first exposure. Demographic data is available for the nation as a whole; however, to ensure anonymity demographic variables are not available at the state level.

Two states (Arizona and Maryland) have not passed laws that allow for the use of medical marijuana, but have regulations that are favorable toward medical marijuana usage. In 1996, Arizona voters approved Ballot Proposition 200, which in part allowed permitted doctors to recommend Schedule I controlled substances, including marijuana, to treat a disease or to relieve pain and suffering in seriously ill and terminally ill patients (ProCon.org, 2010). In Maryland, Senate Bill 502 was approved in 2003 which allows defendants being prosecuted for the use or possession of marijuana to introduce evidence

of medical necessity and physician approval, which could be considered by the court as a mitigating factor (ProCon.org, 2010). Neither Arizona nor Maryland was classified as a medical marijuana state for the purpose of this study.

For purposes of this study, twelve states have also been labeled as “decriminalized.” Decriminalization refers to a reduction in state level sanctions for possessing small quantities of marijuana. Decriminalization of marijuana on the state level does not revert marijuana to the status of a legal good, but designates first-offense marijuana possession as a civil offense rather than a criminal one, resulting in small monetary sanctions rather than prison sentences (Model, 1993). These states include Alaska, Arizona, California, Colorado, Maine, Minnesota, Mississippi, Nebraska, New York, North Carolina, Ohio, and Oregon. These twelve states have commonly been referred to as “decriminalized” in the drug policy debate literature and are commonly grouped together in empirical analyses (Pacula et al., 2003).

Descriptive Statistics

Table 1 represents state level data of the age groups 12-17, 18-25, and 26 and older. Variables include past month marijuana consumption (% reporting use), marijuana risk perception (% reporting great health risk of smoking marijuana once a month), marijuana price per gram (2007 dollars), residing in a medical marijuana state (0= no, 1= yes), residing in a decriminalized marijuana state (0= no, 1= yes), marijuana possession personal use quantities maximum years of imprisonment for first offense (then-year sentence), marijuana possession criminal classification type for first offense (0= petty crime, 1= misdemeanor, 3 = felony), and marijuana possession maximum fine for first

offense personal use quantities (logged then year dollars). Marijuana possession maximum fine was logged due to the large maximum monetary fine (\$150,000) for the state of Arizona.

TABLE 1 Descriptive Statistics All Age Groups 1999-2007						
Variable	Scale	Mean	Std. Dev.	Min	Max	Obs
MjSmkPastMonth (0=no, 1=yes)	% reporting	9.360458	6.016256	1.27	32.79	1377
MjRiskPerception (1=no risk, 2=slight risk, 3=moderate risk, 4=great risk)	% reporting	34.03374	9.339651	10.24	61.5	1377
MjPricePerGram	2007 dollars	10.29553	2.517679	5.17	16.33	1377
MedMj (0=no, 1=yes)	0-1	0.1742919	0.3794982	0	1	1377
DecriminaledState (0=no, 1=yes)	0-1	0.2352941	0.4243366	0	1	1377
MjMaxYrsPrison	then year sentence	0.5900218	0.6346043	0	4	1377
MjCrimClass	1-3	1.823529	0.4732047	1	3	1377
MjMaxFine	nominal dollars	3951.634	20688.13	0	150,000	1377

Consumption Trends and Perceptions of Health Risk

As shown in Table 2, marijuana consumption is highest for the age groups with the lowest level of risk perception. Mean perception that occasional use (once a month) of marijuana is a great risk for age group 12-17 was 34.61% with a corresponding past month consumption rate of 7.79%. For age group 17-25 mean perception that occasional use of marijuana is a great risk was 24.64% with a corresponding past month consumption rate of 16.51%, and for those age 26 and older the mean perception that occasional use of marijuana is a great risk was 42.85% with a corresponding past month youth consumption rate of 3.78%.

TABLE 2 Marijuana Consumption Past 30 Days and Perception of Harm by Age Group 1999-2007						
Age 12-17	Scale	Mean	Std. Dev.	Min	Max	Obs
MjSmkPastMonth	% reporting	7.791895	1.722631	4.39	13.9	459
MjRiskPerception	% reporting	34.60967	4.740224	22.61	48.03	459
Age 18-25						
MjSmkPastMonth	% reporting	16.50512	4.409597	7.44	32.79	459
MjRiskPerception	% reporting	24.63924	5.424765	10.24	41.28	459
Age 26+						
MjSmkPastMonth	% reporting	3.784357	1.244127	1.27	7.99	459
MjRiskPerception	% reporting	42.85231	6.591783	26.33	61.5	459

From 1999 through 2007 the percentage of individuals in all age ranges who consumed marijuana within the past 30 days increased by 11.4%, while the perception of harm from occasional marijuana consumption decreased 10.79% (Table 3). For the age group 12-17 the percentage of individuals who consumed marijuana within the past 30 days decreased by 12.68%, with the perception of harm from occasional marijuana consumption decreasing by 5.74%. For those ages 18-25 past month consumption increased 18.18% with the perception of harm decreasing 14.60%, and for ages 26 and up consumption increased 42.40% with perception of harm decreasing by 12.52%. This suggests that as risk perception decreases consumption increases, especially for those 18 and older.

TABLE 3 Marijuana Consumption Past 30 Days and Perception of Harm by Age Group 1999 and 2007			
All Ages	1999 Mean	2007 Mean	Obs
MjSmkPastMonth	8.47%	9.44%	153
MjRiskPerception	36.86%	32.88%	153
Age 12-17			
MjSmkPastMonth	7.92%	6.92%	51
MjRiskPerception	36.52%	34.42%	51
Age 18-25			
MjSmkPastMonth	14.52%	17.16%	51
MjRiskPerception	27.24%	23.26%	51
Age 26+			
MjSmkPastMonth	2.99%	4.25%	51
MjRiskPerception	46.82%	40.96%	51

Current Marijuana Smoker

With respect to the dependent variable of current marijuana smoker, marijuana health risk perception ($r = -.884$, $p < .05$) showed the strongest correlations to current marijuana consumption for all age groups (Table 4). This indicates that consumption of marijuana increases as the perception of health risks decreases. Price per gram ($r = .094$, $p < .05$) has a weak correlation to past month marijuana consumption suggesting that consumers are not price sensitive at this level of consumption. Residing in a medical marijuana state ($r = .153$, $p < .05$), decriminalized state ($r = .05$), marijuana possession fines ($r = -.030$), criminal classification ($r = -.096$, $p < .05$), and maximum years in prison ($r = .024$) also are weakly correlated to past month marijuana consumption for all age groups.

TABLE 4 Correlation All Age Groups 1999-2007									
	X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
MjSmkPastMonth	1								
MjRiskPerceptionn	-0.884*	1							
MjPricePerGram	0.0941*	-0.1837*	1						
MedMj	0.1527*	-0.2474*	0.2205*	1					
DecriminalizedState	0.0499	-0.0725*	0.0038	0.3409*	1				
MjMaxYrsPrison	-0.024	0.0352	0.0262	-0.0569*	-0.4251*	1			
MjCrimClass	-0.0961*	0.1259*	0.1929*	-0.0957*	-0.3794*	0.543*	1		
MjMaxFine	-0.0303	0.0247	0.1050*	-0.0653*	0.2385*	0.126*	0.3717*	1	
AgeRange	-0.2720*	0.3604*	0.00	0.00	0.00	0.00	0.00	0.00	1

* p < .05

Changing state level laws that allow for medical marijuana will increase demand, leading to an initial increase in prices. A weak positive correlation ($r = .221$, $p < .05$) exists between marijuana price per gram and a state that allows for medical marijuana for all age ranges. This price increase is expected to be short-term, until which time additional medical marijuana dispensaries are established and opened for business, leading to increased competition followed by long run price decreases.

Medical marijuana state and the risk perception of harm by consuming marijuana has a stronger correlation than between price and health perception. This correlation of medical marijuana state and health risk perception ($r = -.247$, $p < .05$) indicates that as more state laws allow for medical marijuana the perception that marijuana consumption does not pose a great threat on one's health increases. As states allow for marijuana use as medication, the perception is not only that marijuana consumption is not harmful, but it also can actually benefit persons and ameliorate certain conditions. Perceived medical benefit has led to an increase in consumption, as was the case of alcohol consumption in Australia which realized an increase in regular drinkers from 1995 to 2001 when

consuming small amounts of alcohol was professed to have health benefits (Zhao & Harris, 2004).

Among the three age ranges the strongest negative correlation with past month marijuana smoking is marijuana health risk perception. The strongest negative correlation was seen in the 12-17 year olds ($r = -.702, p < .05$), then the 26 years and older ($r = -.755, p < .05$), and the strongest negative correlation was for those 18-25 ($r = -.830, p < .05$). The perception of risk of consuming marijuana is correlated negatively with marijuana use (Hemmelstein, 1995).

Among 12-17 and 18-25 year olds, residing in a medical marijuana state was also weakly correlated ($r = .355, p < .05$; and $r = .340, p < .05$), with past month marijuana consumption. For those age 26 and up, residing in a medical marijuana state is moderately correlated with past month marijuana consumption ($r = .519, p < .05$). Marijuana health risk perception was also moderately negatively correlated for the age ranges of 12-17 and 26 and older ($r = -.402, p < .05$; $r = -.490, p < .05$) with residing in a medical marijuana state. Marijuana health risk perception is weakly negatively correlated for the age range of 18-25 ($r = -.332, p < .05$). This suggests that the legal acceptance of medical marijuana negatively influences the perceived health risk of consumption.

Price has the greatest influence on past month marijuana consumption for those age 26 and older, ($r = .406, p < .05$), followed by ages 18-25 ($r = .256, p < .05$). Price has almost no influence on those 12-17 ($r = .038$), although this is not statistically significant.

The variables with the weakest correlation among 12-17 year olds with current marijuana consumption are maximum years in prison ($r = .011$) and maximum monetary fine ($-.028$), although none are statistically significant at the .05 level. For those age 18-

25 the variables with the weakest correlation are maximum years in prison ($r = -.094$, $p < .05$), maximum monetary fine ($r = -.101$, $p < .05$), and decriminalized state ($r = .109$, $p < .05$). For those age 26 and over the variables with the weakest correlation are maximum years in prison ($r = -.033$), although not statistically significant, maximum monetary fine ($r = -.042$, $p < .05$), and marijuana possession criminal classification ($r = -.123$, $p < .05$). This indicates that statutory penalties intended to discourage marijuana consumption will have little effect on marijuana consumption for this age group. Marijuana is also price inelastic for this age group, resulting in little change in consumption as price increases.

OLS Regression

An ordinary least squares (OLS) regression was performed to measure the influence multiple variables have on past month marijuana consumption. Residing in a medical marijuana state ($\beta = -1.074$) was the strongest single predictor of past month marijuana use. Marijuana possession criminal classification for marijuana possession ($\beta = .656$) was the second strongest influencer, marijuana health risk perception was third strongest ($\beta = -.590$), residing in a marijuana decriminalized state ($\beta = .454$) is fourth, and marijuana price per gram ($\beta = -.157$) was fifth strongest respectively. Possible maximum monetary fine for marijuana possession was the weakest influencer on youth marijuana consumption with almost zero effect.

All variables in the model were significant at a minimum of the .05 level, except for decriminalized state and marijuana possession maximum years in prison. Examined as a whole, this model explains 79% ($R^2 = .7909$) of the variance shown in past month

marijuana consumption for all age groups during the years 1999-2007. Results of the OLS are displayed in Table 5.

TABLE 5 OLS Regression All Age Groups 1999-2007					
				Number of obs = 1377	
				F (7, 1369) = 739.90	
				Prob > F = 0.0000	
				R-squared = 0.7909	
				Adj R-squared = 0.7899	
				Root MSE = 2.7580	
Source	SS	df	MS		
Model	39392.4538	7	5627.4934		
Residual	10412.3222	1369	7.60578684		
Total	49804.76	1376	36.1953314		
MjSmkPastMnth	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
MjRiskPerception	-0.5901084	0.0084139	-70.14	0.000	-.6066139 -.5736029
MjPricePerGram	-0.1574451	0.0316834	-4.97	0.000	-.2195982 -.0952919
MedMj	-1.074176	0.226147	-4.75	0.000	-1.517808 -.6305442
DecriminalizedState	0.4536885	0.2394669	1.89	0.058	-.0160734 .9234504
MjMaxYrsPrison	-0.0411901	0.1472103	-0.28	0.780	-.3299723 .2475921
MjCrimClass	0.6560762	0.2225001	2.95	0.003	.2195981 1.092554
MjMaxFine	-9.14E-06	4.43E-06	-2.06	0.039	-.0000178 -4.41e-07

For the age range 12-17, the variables with the greatest influence on past month marijuana consumption, when holding all other variables constant, are residing in a medical marijuana state ($\beta = .464$, $p < .05$) and marijuana health risk perception ($\beta = -.267$, $p < .05$). Marijuana possession maximum fine ($\beta = .000$) demonstrated no influence on past month marijuana consumption, although not at a statistically significant level. For the age range 12-17 the OLS model explains 54% ($R^2 = .5425$) of the variance shown in past month marijuana consumption.

For those age 18-25, marijuana possession criminal classification ($\beta = -1.31$, $p < .05$), residing in a medical marijuana state ($\beta = .846$, $p < .05$), and marijuana health risk perception ($\beta = -.616$, $p < .05$), showed the greatest influence on past month marijuana consumption. The OLS model when examining the age range 18-25 explains 70% ($R^2 =$

.704) of the variance shown in past month marijuana consumption. The variable with the weakest influence on past month marijuana consumption is marijuana possession maximum fine ($\beta = .000$), although not statistically significant.

The variables with the greatest influence on past month marijuana consumption for those 26 and older are residing in a medical marijuana state ($\beta = .518$, $p < .05$), residing in a decriminalized state ($\beta = .213$, $p < .10$), and marijuana health risk perception ($\beta = -.114$, $p < .05$). The OLS model when examining this age range explains 62% ($R^2 = .623$) of the variance shown in past month marijuana consumption. The variable with the least influence on past month marijuana consumption is marijuana possession maximum fine ($\beta = .000$), although not statistically significant.

Price was not a significant influence on past month marijuana consumption among the age ranges of 12-17, 18-25, and 26 and older ($\beta = -.147$, $\beta = .111$, and $\beta = .083$ respectfully) with all being statistically significant at the .05 level. This contradicts previous studies that have demonstrated that price has an inverse relationship with marijuana consumption (Caulkins & Reuter, 1998; Clements & Daryal, 1999; Grossman, Chaloupka, & Shim, 2002; Pacula et al., 2000), with one study demonstrating that price plays a “significant” factor in marijuana consumption (Daryal, 1999).

CHAPTER III

RESULTS

This study demonstrates the complex nature of health risk behaviors on an ecological level, and the need for policymakers to account for the numerous variables involved, rather than focusing on only a single variable, such as price. The influence of these variables is relevant for gaining a better understanding of health risk behaviors.

Marijuana use has also been demonstrated to result in enormous social costs. These social costs include a variety of cancers, mental illness, and lost productivity. Marijuana, the most commonly used illegal drug in the developed world, has generated tremendous revenues. State and federal governments have only recently begun collecting tax monies.

Perceptions of health risk of marijuana vary from persons age 12-17, 18-25, and 26 years of age and up. Of the three age groups, persons age 26 and older perceive the health risks to be the greatest for occasional marijuana consumption, trailed by youths age 12-17, and 18-25 with the lowest perception of health risk. This demonstrates that the health risk perception of smoking marijuana once a month decreases in adolescence before increasing after the age of 26. For optimal efficiency, anti-marijuana policies need to be designed and implemented that focus on increasing the perception of health risk among this youngest age group. The probability that youths initiate participation in one of

these health risk behaviors is higher than that of adults due to their lower perception of health risk (Cohn, Macfarlane, Yanez, & Imai, 1995). This hypothesis is reinforced by this study as we have demonstrated that as an individual's age increases, he/she is less likely to consume marijuana since as one ages their negative health risk perception of marijuana consumption increases.

Statutory penalties have also been shown to have little success in discouraging long-term consumption of marijuana. These penalties, both in monetary terms and/or imprisonment, are inadequate deterrents primarily due to the fact that they remain mostly unknown by the offenders. This is not to suggest that these penalties be removed, but rather to suggest that they are included into policies that aim at educating youths on the risks of using such substances. Enforcement must also be continued due to the fact that if enforcement is lax or nonexistent the deterrent effect is weakened. Designing policies that educate end-users to the actual penalties of marijuana use and possession into messages intended to increase the health risk perception of marijuana consumption may enhance the goal of youth marijuana cessation.

Youth involvement in the health risk behavior of marijuana consumption can be reduced simply by raising the level of perceived risk (Cohn et al., 1995). Tobacco policies have had tremendous success in raising this level of health risk perception in the past by anchoring tobacco policy firmly in the area of public health rather than the legal system.

CHAPTER IV

DISCUSSION

Several of the environmental factors that lead to health risk behaviors have been identified in this study. Prior to designing and implementing new anti-marijuana strategies, policy makers must answer one question: Is marijuana consumption a health risk? If the answer is yes, then the design of anti-marijuana policy must be shifted away from law enforcement policy and into the field of public health policy. This is not to be confused with advocating for marijuana legalization and/or decriminalization, but rather a paradigm shift in the problem of marijuana consumption itself. Law enforcement policy, which has primarily focused on the supply-side of marijuana, has not been successful in designing long-term initiatives to reduce youth marijuana consumption. These policy shortcomings have opened the door for some to question the efficiency of said policies. In addition to the efficiency debate concerning anti-marijuana policies, initiatives suggesting legalizing and taxing marijuana have gained momentum as an additional revenue stream in these trying economic times. During this debate, health outcomes concerning marijuana use are surprisingly absent. Public health officials must become involved in the policy process aiding in the design of demand-side policies intended to reduce the prevalence of youth marijuana consumption. Law enforcement's role should be concentrated on actively enforcing existing marijuana regulations while these new public health policies are implemented.

Current resources directed at supply-side policies (law enforcement and/or military strategies) designed to increase the overall cost of marijuana should be reduced and reallocated toward policies that are more cost effective. Prior studies have also concluded that supply-side initiatives have had little long-term effects on illegal drug consumption or beneficial public health outcomes (Dobkin & Nicosia, 2008; Wood et al., 2003). The correlation of current marijuana smoker and price per-gram of marijuana ($r = .094$) is weak, and even suggest marijuana is not a normal good.

Demand-side initiatives, such as treatment and education, have been successfully implemented on the part of public health officials in reducing tobacco use. The single strongest predictor of ending personal utilization of these goods lies in increasing the perception of harm caused by consumption. Marijuana consumption is similarly influenced by health risk perception. A strong correlation exists between current marijuana consumption and health risk perception ($r = -.884$).

In addition to direct health risk perception initiatives, steps must be taken to decrease the number of states allowing marijuana use for medicinal purposes. The correlation between current marijuana use and medical marijuana state ($r = .153$) is weak for all age groups, but is when each age group is examined separately the correlation is much stronger for those age 12-17 ($r = .3552$), 18-25 ($r = .3401$), and 26 and older ($r = .5193$). As marijuana for medicinal purposes becomes normalized youth's perception that marijuana is not harmful increases, leading to increased usage. Restrictions, or lack thereof, reinforce the norms and expected behavior of the individual within their environment.

Demand-side policies that focus on increasing the health risk perception of marijuana consumption may result in a decrease of youth marijuana use. During the time period of this study, the majority of marijuana policy funding was designated for enforcement and not educational purposes. In 2009 \$100 million of the \$13.7 billion budget for the White Houses' National Drug Control Strategy was allocated for the purpose of educating youth on the harms of illegal drug use. There is not a lack of drug control policy funds, but rather these funds have largely been misdirected, focusing primarily on supply-side policies. If marijuana policies mirrored those of anti-tobacco policies that have successfully increased the health risk perception, then the expectation would be for marijuana consumption to also decrease.

Future Research

The complex a dataset developed for this study is not without its weaknesses. The narrow time frame of 1999-2007 presents questions concerning the applicability of any conclusions drawn from this analysis. Limitations of information contained within more recent data sources restricted the timeframe available. The real significance of this study is an enhanced understanding of how these variables as a whole interact and influence behavior. We have demonstrated that health risk perception of marijuana is the key variable influencing this health risk behavior. We have also demonstrated that variables such as criminal sanctions and price, when examined en masse, play a much smaller role than previous studies have suggested.

Additional data that would have been effective for further analysis in this study was state level demographic information. Due to the fact that survey participants could

potentially be identified, through a form of reverse engineering responses, state level data are not available with regards to certain demographic variables such as race, sex, and gender. This information may have provided specific state level consumption patterns based on these demographic variables that the available more general data does not provide.

Furthermore, this study should not be interpreted as suggesting that no additional health risk behaviors warrant examination with regard to their association with youth marijuana consumption. Youths who participate in one form of risky behavior are more likely to participate in another (Bentlin, Slovic, & Severson, 1993). Additional health risk behaviors that merit future examination include alcohol consumption, unprotected sex, and other illicit drug use such as ecstasy, cocaine, and heroin, to name but a few.

Alcohol also merits future assessment as to what degree alcohol use among youths is associated with marijuana consumption due to the high likelihood of abuse and ease of access. Studies have shown that youths who consume alcohol are more likely than non-drinkers to have an opportunity to try marijuana (Wagner & Anthony, 2002).

Identifying additional associations between health risk behaviors is vital to increasing the public health of society, and youths in particular, due to the fact that if one behavior is reduced or eliminated then the complementary behavior may also be reduced. Reframing many of these health risk behaviors from the criminal justice spectrum to one of public health allows health policy makers, advocacy groups, and health organizations to design and implement educational initiatives that have a higher probability to produce positive health outcomes.

Despite these potential shortcomings, the data sources utilized were extremely comprehensive and allowed us to examine several variables that were strongly associated with the health risk behaviors of youth marijuana consumption. By examining these numerous variables a clearer understanding of the environmental influences on health outcomes were formed, while also allowing us to identify the factors that have not been successful in altering youth health risk behaviors.

Overall, this study has demonstrated that the single strongest determinant of the health risk behavior of marijuana consumption is the perception of health risk. By shifting marijuana policy from the realm of law enforcement and into the domain of public health, policy makers can increase the probability of creating a successful strategy that will reduce both the prevalence and incidence of youth marijuana consumption. The dilemma is not that there is a lack of resources, but rather that these resources are misdirected. By focusing on creating policies that educate youths on the dangers of marijuana consumption, health risk perception will increase. This will result in a decrease in the number of adolescent marijuana smokers, mirroring the positive results that anti-tobacco policies achieved through public health initiatives.

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